



Aerial Triangulation Report

13165

**Mobile County,
Alabama**



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ACQUISITION DATES

Atlantic has successfully completed aerial triangulation (AT) of the digital imagery acquired for Mobile County, Alabama. Aerial imagery acquisition for this project was completed in six (6) missions flown on 13th, 14th, 18th, 21st and 25th of March.

DATUM REFERENCE

Data produced for the project were delivered in the following reference system.

Horizontal Datum: The horizontal datum for the project is NAD_1983

Vertical Datum: The Vertical datum for the project is North American Vertical Datum of 1988,

Coordinate System: NAD_1983_StatePlane_Alabama West_FIPS_102_Feet

Units: Horizontal units are in U.S. Survey Feet, Vertical units are in U.S. Survey Feet.

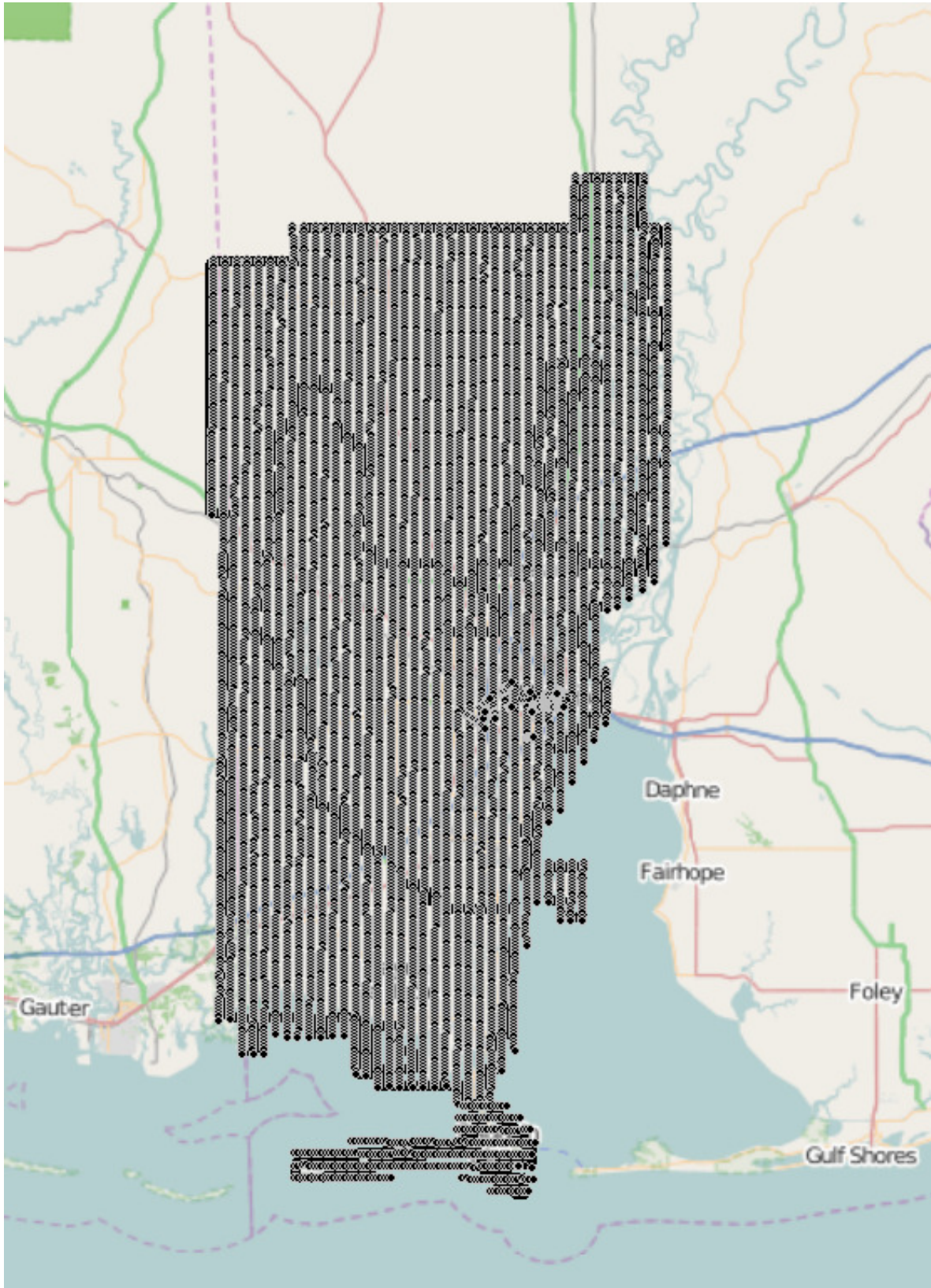
Geoid Model: Geoid12A

Imagery Acquisition Details

PROJECT AREA

Average Flight height (AMSL):	4,724.152 feet
Average Ground Elevation:	570.118 feet
Average Flight Height (AGL):	4,154.034 feet
Max RMS X:	0.415
Max RMS Y:	0.415
Max RMS Z:	0.461
Max Residual X:	1.246
Max Residual Y:	1.246
Max Residual Z:	1.384

FLIGHT PLAN



Airborne – GPS/INS Processing

The airborne-GPS data was processed using POSPac™ (version 5.2) Mobile Mapping Suite; a GPS-IMU tightly coupled processing software which uses Kalman Filtering techniques, On-The-Fly (OTF) ambiguity resolution techniques and multiple CORS stations utilizing SmartBase trajectory processing.

SMARTBASE PROCESSING TECHNIQUE

Applanix SmartBase processing mode creates a virtual base station, which follows plane trajectory allowing faster and more accurate on the flight kinematic ambiguity resolution. In order to process trajectory in SmartBase processing mode multiple CORS stations (usually from 6 to 11 CORS stations per mission) are imported into the project. The network of the CORS stations creates a closed polygon around the plane trajectory. Within the polygon atmospheric corrections are well modeled and applied to each photo center. One of the most reliable CORS stations is chosen as primary station. The SmartBase quality check is performed on all CORS stations involved in the network. Any CORS stations failing QAQC check are eliminated from processing. In the following step Applanix SmartBase CORS network adjustment is run to adjust all CORS stations to a common datum. The final step in Applanix SmartBase processing is ‘GNSS-Inertial Processor’ which combines GPS CORS data with inertial data in a tightly coupled process. SmartBase processing creates a virtual base station, which follows plane trajectory within the SmartBase region polygon. All CORS stations contribute to virtual base station accuracy.

The precise position of the camera lens node was interpolated from the trajectory of GPS positions utilizing polynomial fitting techniques. The time-tag for each event served as a basis for the interpolation.

The lever arm offset values are applied to this data resulting in a final AGPS file containing the coordinates of the camera lens node at each instance of exposure. Final Exterior Orientation parameters and positions are outputted using project assigned datum, projections and units.

ABGPS GROUND REFERENCE STATIONS

POSPac 5.2 SmartBase processing technique requires multiple GPS ground reference stations of at least 18 hours of data to process plane trajectory. The networks of CORS stations imported into PPAO project, created ‘SmartBase Region’ polygon for each mission. The ‘SmartBase Region’ assists in virtual base station creation and atmospheric corrections model.

AERIAL TRIANGULATION

OVERVIEW

The main objective of aerial triangulation is to produce from ground control points, airborne GPS data, and inertial measurement data sufficient points in photogrammetric models to ensure that each model can be oriented accurately as required for stereo compilation in either orthoimagery or line mapping in digital or analogue form.

PROCESSING METHODOLOGY

The project area was completed as one (1) aerial triangulation project. Initial processing began with extraction and refinement of airborne GPS data to acquire accurate External Orientations (EOs). External Orientation data was applied to digital imagery as part of the initial introduction into the Image Station Automatic Triangulation (ISAT) workflow. Once introduced into ISAT, contiguous blocks were created to facilitate automatic point measurement resulting in tie and pass points. Once complete, blundered points are removed and the block is further analyzed for weak areas and if required manual points are added.

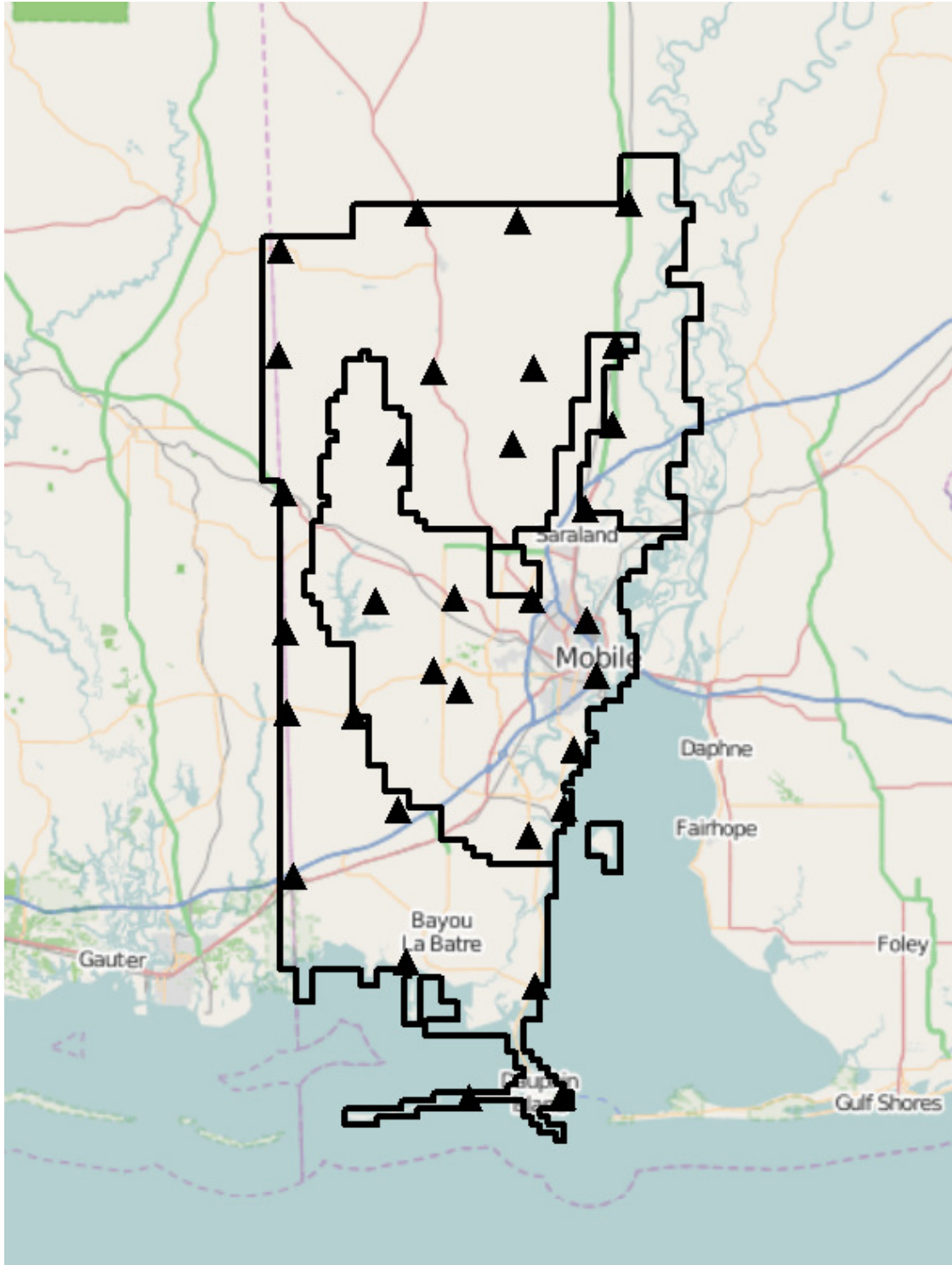
CONTROL POINT LISTING AND DISTRIBUTION

Control POINTS (NAD83_SPCS_Alabama West, NAVD88, USFT)

Point	Easting	Northing	Elevation
MOB_01	1707723.851	231948.233	152.578
MOB_02	1750079.344	91170.187	4.393
MOB_03	1785012.732	197931.864	8.789
MOB_04	1809029.638	420330.734	52.634
MOB_05	1788652.095	219044.079	7.844
MOB_06	1803224.380	338722.672	37.090
MOB1000	1793057.733	308182.039	17.980
MOB1008	1715439.334	273862.198	224.560
MOB1009	1744534.667	275420.792	221.875
MOB1010	1773073.725	274350.173	49.199
MOB1011	1793632.220	266929.229	27.588
MOB1023	1746379.675	241213.062	117.797
MOB1031	1723488.987	196897.684	147.378
MOB1033	1785099.081	197950.725	9.056
MOB1034	1772107.821	187682.871	28.612
MCC1050	1784782.361	91837.615	3.002
MCC1052	1774544.848	132437.323	7.640
MCC1058	1684997.093	172953.863	12.833
MCC1060	1682898.585	232830.420	106.720
MCC1061	1682075.483	262497.765	172.195
MCC1062	1681687.996	314135.123	84.308
MCC1063	1724288.791	329139.772	284.934
MCC1064	1766014.891	332030.804	244.375
MCC1066	1773655.573	360058.500	266.055
MCC1067	1737081.728	358599.314	128.378
MCC1069	1679895.638	364539.765	161.361
MCC1070	1804219.559	368142.570	48.822
MCC1071	1680077.391	403601.402	268.176
MCC1072	1768019.871	413813.672	300.531
MCC1073	1731081.579	416813.486	215.885
03-42-12	1796878.990	246393.980	13.946
CIPF	1726922.669	141470.489	2.722
MOB_AP_STA_A1	1736885.806	248363.427	209.803

Fully Constrained Adjustment

The final adjustment, and the optimal solution to be used for mapping, included the following control points as constraints.



CONTROL POINT RESIDUALS

Control Point Residuals

Point	Status	Type	Class	VX	VY	VZ	V(XYZ)
MOB_01	Measured	Control	XYZ	0.066	-0.007	-0.392	0.397
MOB_02	Measured	Control	XYZ	-0.089	0.251	0.012	0.266
MOB_03	Measured	Control	XYZ	0.165	-0.115	0.014	0.201
MOB_04	Measured	Control	XYZ	0.259	-0.131	0.115	0.312
MOB_05	Measured	Control	XYZ	0.150	-0.187	0.084	0.254
MOB_06	Measured	Control	XYZ	-0.419	0.256	-0.033	0.492
MOB1000	Measured	Control	XYZ	-0.160	0.133	0.560	0.597
MOB1008	Measured	Control	XYZ	0.005	0.139	0.022	0.140
MOB1009	Measured	Control	XYZ	0.108	0.124	0.260	0.308
MOB1010	Measured	Control	XYZ	0.442	0.067	-0.016	0.447
MOB1011	Measured	Control	XYZ	-0.123	0.195	0.051	0.236
MOB1023	Measured	Control	XYZ	0.180	0.197	0.017	0.267
MOB1031	Measured	Control	XYZ	-0.083	0.167	0.211	0.281
MOB1033	Measured	Control	XYZ	0.028	-0.059	-0.006	0.065
MOB1034	Measured	Control	XYZ	0.007	0.000	0.271	0.271
MCC1050	Measured	Control	XYZ	-0.024	0.051	0.000	0.056
MCC1052	Measured	Control	XYZ	0.152	0.181	-0.005	0.237
MCC1058	Measured	Control	XYZ	-0.093	0.074	-0.040	0.126
MCC1060	Measured	Control	XYZ	0.200	0.282	0.145	0.375
MCC1061	Measured	Control	XYZ	0.023	0.206	0.010	0.208
MCC1062	Measured	Control	XYZ	0.497	0.252	-0.049	0.559
MCC1063	Measured	Control	XYZ	0.004	-0.073	-0.118	0.139
MCC1064	Measured	Control	XYZ	0.218	0.213	-0.013	0.305
MCC1066	Measured	Control	XYZ	0.507	0.156	0.116	0.543
MCC1067	Measured	Control	XYZ	0.175	-0.102	0.087	0.220
MCC1069	Measured	Control	XYZ	0.708	0.034	-0.085	0.713
MCC1070	Measured	Control	XYZ	0.058	0.298	0.150	0.338
MCC1071	Measured	Control	XYZ	-0.090	-0.085	-0.078	0.146
MCC1072	Measured	Control	XYZ	-0.225	0.580	-0.070	0.626
MCC1073	Measured	Control	XYZ	0.596	0.265	0.090	0.658
03-42-12	Measured	Control	XYZ	0.266	-0.201	0.167	0.373
CIPF	Measured	Control	XYZ	0.498	-0.605	0.652	1.020
MOB_AP_STA_A1	Measured	Control	XYZ	0.046	0.800	-0.033	0.802

Anomalies and Misfits

Un-used Control Points

There were no unused control points identified for this project.

SUMMARY OF AT RESULTS

Photo-T Options

Adjustment Mode:	Absolute
Precision Computation:	Enabled
Error Detection:	Disabled
Camera Calibration:	Disabled
Self-Calibration:	Disabled
Given EO/GPS:	Enabled
Antenna Offsets:	Disabled
GPS Shift/Drift Correction:	Disabled
INS Shift/Drift Correction:	Disabled

Photo-T Parameters

Parameter	X/Omega	Y/Phi	Z/Kappa	XY
RMS Control:	0.274	0.259	0.194	0.267
RMS Limits:	0.415	0.415	0.461	
Max Ground Residual:	0.708	0.800	0.652	
Residual Limits:	1.246	1.246	1.384	
Mean Std Dev Object:	0.109	0.078	0.254	
RMS Photo Position:	0.049	0.064	0.096	
RMS Photo Attitude:	0.096	0.037	0.046	
Mean Std Dev Photo position:	0.079	0.083	0.054	
Mean Std Dev Photo Altitude:	0.001	0.001	0.001	

Key Statistics

Sigma:	2.6 um
Number of Iterations:	2
Degrees of Freedom:	313203

Current Count

Control Points Used:	33
Check Points Used:	0
Photos Used	8212
Photos Not Used:	532
Image Points Used:	271077

CAMERA CALIBRATION



Calibration Protocol
DMC01 - 0001



Calibration Certificate

Digital Mapping Camera (DMC)

DMC Serial Number: **DMC01-0001**

CBU Serial Number: **01000001**

For

The Atlantic Group

6767 Old Madison Pike, #267
Huntsville, Alabama 35806

USA





System Overview

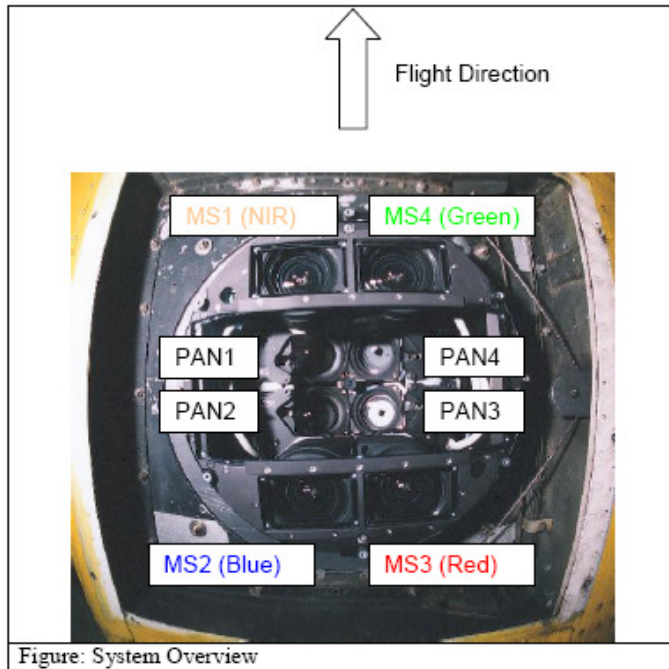
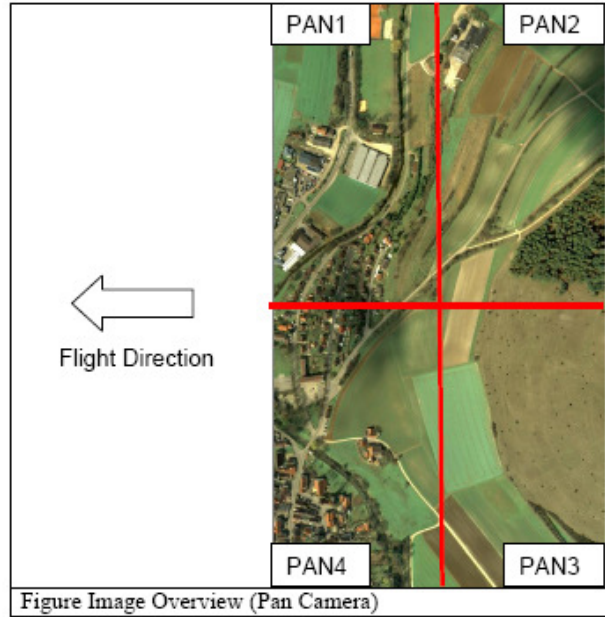


Figure: System Overview



Camera Parameter for Virtual Image (High Resolution)

Virtual Focal Length [m]	0.12
Virtual Sensor Size [Pixel]	13824 x 7680
Virtual Pixel Size [μm]	12
Virtual Principle Point [mm]	X = 0.0 Y = 0.0
Distortion Parameter	Distortion Free

Camera Parameter for Virtual Image (Color Resolution) before Version PPS 5.0.10.3

Virtual Focal Length [m]	0.12 / 4.75
Virtual Sensor Size [Pixel]	3072 x 2048
Virtual Pixel Size [μm]	12
Virtual Principle Point [mm]	X= -0.646 Y=0.646
Distortion Parameter	Distortion Free



Calibration Protocol
DMC01 - 0001



**Camera Parameter for Virtual Image (Color Resolution) after
Version PPS 5.1.10.3**

Virtual Focal Length [m]	0.030
Virtual Sensor Size [Pixel]	3456x1920
Virtual Pixel Size [μm]	12
Virtual Principle Point [mm]	X = 0.0 Y = 0.0
Distortion Parameter	Distortion Free

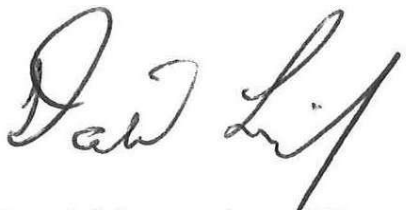
To Whom It May Concern:

The calibration and Aerial Triangulation procedures used to arrive at the results outlined in this report are in full compliance with the recommendations for in-situ calibration from Z/I Imaging and established industry standards.

I, David Levering, certify that the Digital Aerial Photography and Analytical Aerial Triangulation were performed under my supervision and the results conform to the project specifications and to ASPRS Class II accuracy standards.

Should you require any additional information or clarification, please contact me directly at 256.971.9991 (office),

Sincerely,

A handwritten signature in black ink that reads "David Levering". The signature is written in a cursive style with a large initial "D" and a long, sweeping underline.

David Levering CP
Geospatial Analyst
ASPRS Certified Photogrammetrist #1522